

AD-A046 610

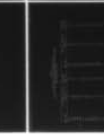
NAVY PERSONNEL RESEARCH AND DEVELOPMENT CENTER SAN D--ETC F/6 5/1
ANALYSIS OF DEMANDS ON THE SAN DIEGO-BASED INTERMEDIATE MAINTEN--ETC(U)
NOV 77 T A BLANCO, M W ROWE

UNCLASSIFIED

NPRDC-TR-78-1

NL

| OF |
AD
A046610



END

DATE

FILMED

12-77

DDC

1.0

1.1

1.25

1.5

1.6

1.8

2.0

2.2

2.5

2.8

3.2

3.6

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1973-A

AD A 0 46610

nprdc

NAVY PERSONNEL RESEARCH AND DEVELOPMENT CENTER, SAN DIEGO, CALIFORNIA 92152

10 *2*

NPRDC TR 78-1

NOVEMBER 1977

**ANALYSIS OF DEMANDS ON THE SAN DIEGO-BASED
INTERMEDIATE MAINTENANCE ACTIVITIES**

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED

D D C
DRAFT
NOV 21 1977
RECEIVED

AD No. _____
DDC FILE COPY

14 NPRDC-TR-78-1

11 November 1977

6 ANALYSIS OF DEMANDS ON THE SAN DIEGO-BASED
INTERMEDIATE MAINTENANCE ACTIVITIES.

12 25p.

10 Thomas A. Blanco
Murray W. Rowe

9 Interim rept.,

Reviewed by
Joe Silverman

16 ZP109

DDC
RECEIVED
NOV 21 1977
F

17 ZQ109PNQ6

Approved by
James J. Regan
Technical Director

Navy Personnel Research and Development Center
San Diego, California 92152

390 772

mt

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NPRDC TR 78-1	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ANALYSIS OF DEMANDS ON THE SAN DIEGO-BASED INTERMEDIATE MAINTENANCE ACTIVITIES		5. TYPE OF REPORT & PERIOD COVERED Interim
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Thomas A. Blanco Murray W. Rowe		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Navy Personnel Research and Development Center San Diego, California 92152 (Code 303)		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 63707N Z0109-PN.06
11. CONTROLLING OFFICE NAME AND ADDRESS Navy Personnel Research and Development Center San Diego, California 92152 (Code 303)		12. REPORT DATE
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES 26
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE		
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Input-Output Analysis Demand Forecasting Manpower Planning		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) In developing a system for allocating manpower resources in the Navy, major emphasis has been placed on the design of an input-output (I/O) model to forecast the workload of shore activities, based upon the size and distribution of the fleet. To determine the feasibility of I/O analysis for operational use, a full-scale model of the 11th Naval District is being developed. The structure of I/O analysis requires data on the work output of each shore activity and its destination in the fleet and at other shore activities. In		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

PRECEDING PAGE BLANK-NOT FILMED

cont. -> addition, fleet demands must be disaggregated by ship type, movement, and status.

A major effort underway is the collection and organization of data for an empirical analysis of the fleet-shore workload demand network, focusing on 10 major shore activities in the 11th Naval District. This report is concerned with the analysis of workload demand on the San Diego-based Intermediate Maintenance Activities (IMAs).

The structure of demands on the San Diego IMAs was analyzed by using IMA workload data that provided an annual report (in terms of man-hours expended) on all work being performed on each ship and shore activity. The data were used to determine the division of workload between fleet and shore customers, the proportion of workload accruing to each ship type, the feasibility of grouping ships by type, and the difference in workload for different ship types and homeports.

UNCLASSIFIED

FOREWORD

The effort described in this report supports the Fleet Impact on Shore Requirements subproject, an advanced development under the Manpower Requirements Development System project (Z0109-PN). The overall objective of this subproject is to apply econometric and manpower modelling technologies in the prediction and allocation of shore activity level manpower resources as a function of workload and operational force levels. The main effort of FY77 was an empirical study of the fleet and shore demands placed on major shore activities in the 11th Naval District, with the objective of developing an input-output (I/O) model of the fleet-support demand network. This report focuses on the San Diego-based Intermediate Maintenance Activities (IMAs).

Acknowledgments are due to Mr. E. Krosky of the Development and Training Center, San Diego/Fleet Maintenance Assistance Group, Pacific (DATC/FMAG, San Diego), who provided assistance and guidance, and to the staffs of both DATC/FMAG and the Supervisor of Shipbuilding, Conversion, and Repair, who were extremely helpful and cooperative throughout the data collection and analysis stages of this study.

J. J. CLARKIN
Commanding Officer

RECEIVED BY	
NTS	White Section <input checked="" type="checkbox"/>
DDC	Blue Section <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
JUSTIFICATION	
BY	
DISTRIBUTION/AVAILABILITY CODES	
DA	SP. ORAL
A	

SUMMARY

Problem

A system for determining Navy manpower requirements and allocating manpower resources must be based on the workload and economic relations among individual shore-support activities. The demand network that links shore activities to one another, and to the fleet, constitutes the economic system of the Navy. To represent this network structure, an input-output (I/O) model of the 11th Naval District is being developed to forecast the workload of shore activities, based on the size and distribution of activity of the fleet. An input-output model of this size requires a significant effort to collect, organize, and analyze data on the source and intensity of demands.

Objective

This report is concerned with the workload demands placed by fleet and shore activities on the San Diego-based Intermediate Maintenance Activities (IMAs), which consist of the Development and Training Center, San Diego/Fleet Maintenance Assistance Group Pacific (DATC/FMAG, San Diego) and an array of tenders and repair ships. The results will be used in developing a full-scale model of the fleet-support demand network of the 11th Naval District.

Approach

The structure of demands on the San Diego IMAs was analyzed by using FY76 IMA workload data that provided an annual report (in terms of man-hours expended) on all work being performed on each ship and shore activity. These data were used to determine the division of workload between fleet and shore activities, the proportion of workload accruing to each ship type, the feasibility of grouping ships by type, and the difference in workload for different ship types and homeports.

Results

The total workload of the San Diego-based IMAs in FY76 was over 2.83 million man-hours with DATC/FMAG, San Diego alone accounting for 1.46 million man-hours (52%). Approximately 90 percent of the total workload (2.55 million man-hours) was attributable directly to ships; and the remaining 10 percent, to shore activities. The largest fleet customers in FY76 were frigates (FFs), destroyers (DDs), guided missile cruisers (nuclear) (CG(N)s), guided missile destroyers (DDGs), and amphibious transport docks (LPDs), in that order. These five ship types accounted for 58 percent of total ship demand on the IMAs.

As would be expected, ships homeported in San Diego dominated the work of the IMAs based there. These ships made up 83 percent of all ships serviced in San Diego and accounted for 95 percent of the IMA ship workload. To study fleet demand, the IMA man-hour expenditure on each ship was analyzed to obtain average annual demand rates by ship type and homeport.

The two largest shore customers, COMNAVSURFPAC and DATC/FMAG, San Diego, accounted for 55 percent of the shore-based demand on the San Diego IMAs. There were 55 shore-based customers in all during FY76.

Conclusions

1. Data are available to measure demands on each of the San Diego IMA activities. These data will easily conform to an I/O framework.
2. The type of ship and homeport of a ship affected demands placed on the San Diego IMAs. An I/O model that includes these demands must stress the resulting differences in workload.
3. Because time since last overhaul affected a ship's IMA demand when the overhaul period was recent, overhaul schedules must be considered when determining IMA demands.

Recommendations

1. Because of the large variance in IMA demand and/or few number of ships observed in some ship types, demand rates should be updated each year for forecasting purposes.
2. This analysis should be extended to include other homeport-based IMAs to reflect total fleet IMA demand, and results should be included as part of a Navy-wide I/O model.

CONTENTS

	Page
INTRODUCTION	1
Problem	1
Purpose	1
Background	2
APPROACH	5
Data Sources and Initial Processing	5
Analysis of Fleet Demand	6
Analysis of Shore-Based Activity Demand	6
RESULTS	7
Analysis of Fleet Demand	7
Largest Customers	7
Average IMA Demand Rates	9
DATC/FMAG, San Diego Proportion of Fleet Demand	11
Analysis of Shore-based Activity Demand	11
CONCLUSIONS	15
RECOMMENDATIONS	17
BIBLIOGRAPHY	19
DISTRIBUTION LIST	21

LIST OF TABLES

	Page
1. Fleet Customers of San Diego-based IMAs, FY76	8
2. Comparison of Relative Variance (%) in Demands on DATC/FMAG, San Diego Alone and on All San Diego-based IMAs, FY76	9
3. Average Demand Rates for San Diego-homeported Ships	10
4. Average Demand Rates for Other Homeported Ships	12
5. Proportion of Fleet Demand Placed on DATC/FMAG, San Diego Alone and on Other San Diego-based IMA Activities, FY76	13
6. Shore-based Customers of San Diego-based IMAs, FY76	14

INTRODUCTION

Problem

The Navy's efforts in developing a system for allocating manpower resources have emphasized the design of an input-output (I/O) model to forecast the workload of shore/support activities, based on the size, configuration, and operating tempo of the fleet. Manpower requirements are then derived from the model's workload forecasts. The I/O structure will link fleet activities (ships and aircraft) to individual shore/support activities (shipyards, supply centers, etc.), as well as indicate linkages among shore activities. By organizing Navy activities in an I/O matrix, the extent to which each activity depends on every other activity for support can be quantified using historical data. For example, I/O analysis can not only determine the impact on shipyard workload of introducing an additional destroyer into the overhaul schedule, but also, and more importantly, it can estimate the increased workload that will be required at a supply center to support the new overhaul. Thus, both direct and indirect effects of fleet changes are captured. It is hoped that the I/O model will answer a wide variety of Navy management questions, such as:

1. For changes in fleet size or mix, what alterations in workload can be expected at each shore activity?
2. What is the impact of changes in the shore establishment on the level of fleet support?
3. If ships are transferred from one homeport to another, what will be the effect on the workload of activities at each port?

An I/O model representing the fleet-support demand network of the 11th Naval District (11ND) is being developed for use by Navy managers. It requires data on the output of each shore activity and the destination of this output in the fleet and at other shore activities. Fleet demands must be broken out by ship and aircraft type and by their movement and status. Because a large data base is essential to an I/O model, current efforts are devoted to collecting, organizing, and analyzing data for use in describing a fleet-support demand network.

Purpose

This data analysis effort focuses on workload demand placed on 10 11ND shore activities.¹ These activities were selected for their wide range of functions, outputs, and data problems; their manpower intensities; and their direct and indirect linkages to the fleet. Furthermore, they comprise about 42 percent of the total 11ND workforce.

¹The activities are the Naval Supply Center, San Diego; Long Beach Naval Shipyard; Naval Air Stations, North Island and Miramar; Naval Regional Medical Center, San Diego; Naval Training Center, San Diego; Naval Station, San Diego; Public Works Center, San Diego; Development and Training Center, San Diego/Fleet Maintenance Assistance Group, Pacific; and the Naval Air Rework Facility, North Island.

The purpose of this report is to provide an analysis of demands on a group of activities that perform intermediate ship maintenance in the 11ND--the San Diego-based Intermediate Maintenance Activities (IMAs).² These activities include the Development and Training Center, San Diego/Fleet Maintenance Assistance Group, Pacific (DATC/FMAG, San Diego), one of the 10 11ND activities selected for data analysis, and an array of tenders and repair ships, which maintain fleet units while they are in port.³

Background

The Navy has three basic ship repair classifications--depot-level, intermediate, and organizational maintenance--distinguished by the level of skill sophistication required. Depot-level maintenance, the most complex, largely involves prescribed overhauls requiring 8 to 11 months in a Navy or private shipyard. Intermediate maintenance involves repairs that are generally peculiar to an individual ship. Each ship is scheduled into one of the maintenance activities by an IMA coordinator during the intervals between fleet duty and scheduled overhaul. Unlike depot-level maintenance, the work at an IMA frequently comprises a series of small actions (involving several hundred man-hours) requiring limited skills and no drydocking. Finally, organizational maintenance, the least intricate, consists mostly of routine work performed by a ship's crew while underway.

A primary limitation on demand for maintenance and repair is the amount of funds available. Ships repaired by the IMAs are not "charged"; instead, the IMAs charge the Commander, Naval Logistics Command, Pacific, who ultimately sends the bill to the Commander in Chief, Pacific Fleet. Most shipwork that is contracted to private facilities is paid for by the type commanders. However, lack of adequate funding may prevent certain desired work from being completed. Further, skill deficiencies in many of the IMA activities may either reduce the speed at which a ship passes through various production shops or preclude some work from being done at all. Finally, only those repairs that can be accomplished during the short time periods between fleet operations are completed.⁴ The remainder of the ship's requirements are delayed or are never finished.

²This report is one of a series on the empirical study of workload demands placed on 11ND shore activities. The other reports are listed in the Bibliography.

³Although tenders and repair ships are officially part of the fleet, the nature of their work requires that they be considered as shore activities in the model. The tenders and repair ships included in this analysis are: USS DIXIE (AD-14), USS PRAIRIE (AD-15), USS GOMPERS (AD-37), USS AJAX (AR-6), and USS JASON (AR-8).

⁴This refers to work that requires the ship to be available "alongside" at one of the IMA activities as opposed to repairs that can be done on components while the ship maintains normal operations. Over 80 percent of IMA repair is attributable to the former.

In a Navy calibration laboratory, time becomes a factor since a ship must be calibrated before deployment. This also applies to an IMA activity, which must operate within the constraints of available resources and space, and a tight operations schedule.⁵ Consequently, the IMAs are forced to set priorities, and certain low priority tasks may never be completed. This suggests that an effective Navy manpower planning system cannot ignore the constraints placed on demand and workload at shore/support establishments.

In view of the above, it is apparent that actual workload at the IMAs during a fiscal year does not necessarily represent true demand by the fleet and shore-based activities.

⁵Blanco, T., Bokesch, W. M., & Sorensen, S. The structure of demands on Navy shore activities. Paper presented at the Operations Research Society of America/The Institute of Management Sciences (ORSA/TIMS) Joint National Meeting, November 1975, Las Vegas, Nevada.

APPROACH

Data Sources and Initial Processing

A statistical description and analysis of the workload demands placed on the San Diego Intermediate Maintenance Activities (IMAs) by the fleet requires a large data base that identifies, as a minimum, the type of ship repaired and gives some indication of the workload generated by the repair action. Such data for DATC/FMAG, San Diego and DATC annexes at Pearl Harbor and Alameda were obtained from the Data Processing Service Center, Pacific Fleet (DPSC PAC), as well as from DATC records, for the 18-month period beginning 1 February 1975 and ending 1 July 1976. Similar data for the tenders and repair ships included in the study were procured from the Supervisor of Shipbuilding, Conversion, and Repair (SUPSHIPS), San Diego. The former source reported total man-hours expended for each repair action for each ship; and the latter, total man-hours expended monthly on each ship or shore activity receiving repairs.

Not all of the data reported were used in the analysis. First, since DATC/FMAG, San Diego's mission had changed in July 1975 from training and repair to ship maintenance, only data for FY76 (July 1975 through June 1976) were useful. Second, for modelling purposes, it was crucial to study only that IMA workload performed in the San Diego area. Thus, only that data which concerned work performed at DATC/FMAG, San Diego and conducted by tenders and repair ships when they were in the San Diego area were included.

"Man-hours expended" in intermediate maintenance was selected as the workload measure rather than such alternatives as "the number of ships repaired by DATC/FMAG, San Diego or the tenders" for several reasons. For example, the latter does not indicate the differences in workload for dissimilar repairs on two cruisers, much less for repairs on two different ship types. Also, DATC/FMAG, San Diego and other IMAs use "man-hours expended" as their workload indicator for planning and scheduling.

Because these data permit an analysis of demands on the IMAs in terms of individual customers, it is possible to determine (1) the feasibility of grouping ships by type, (2) the proportion of the total workload accruing to each ship type, (3) the division of workload between fleet and shore activities, and (4) the difference in workload for different ship types and homeports. If ships of the same type have similar demand patterns, the fleet can be represented by ship types in an I/O model, with the final demand for each type computed by considering the number of ships in that type. When the data are included in an I/O model with data from other activities, the importance of second and higher order effects can be determined.

Initial processing involved calculating the annual total IMA workload for each ship repaired and for each shore activity receiving repairs during FY76. This simply meant summing, for each activity, the DATC and tender man-hours. These results were used to derive distributions of IMA workload by ship type and homeport.

Analysis of Fleet Demand

The analysis of fleet demand on the San Diego-based IMAs focused on ship type and homeport as indicators of the source and intensity of demand. Average demand rates and standard deviations were calculated for each ship type by homeport. This involved looking at 131 ships, 26 ship types, and 8 homeports. The demand rate for a ship was the total man-hours expended on that ship in FY 1976. The demand rates for all ships within a given type and homeport were averaged to obtain an average annual man-hour expenditure for a ship in that type and homeport.

Attempts were also made to determine if the amount of time since a ship's last overhaul (depot-level maintenance), the age of the ship, and displacement tonnage had significant effects on demand for intermediate maintenance. Intuitively, it would seem that, the longer the time since a ship was overhauled, the older the ship, and the greater the displacement tonnage, the more man-hours it would need in intermediate maintenance.

Analysis of Shore-Based Activity Demand

Shore-based activity demand rates were calculated for the 55 San Diego area IMA customers during FY76. Each demand rate is simply the total annual hours expended by the IMAs in support of each activity.

RESULTS

Analysis of the demands on the San Diego-based Intermediate Maintenance Activities (IMAs) showed that the total workload in FY76 was over 2.83 million man-hours. Of that total DATC/FMAG, San Diego accounted for over 1.46 million man-hours (52%). Approximately 90 percent (2.55 million man-hours) of the total IMA workload for FY76 was directly attributable to ships; and the remaining 10 percent (.28 million man-hours), to shore-based activities. Thus, concentration was focused on analyzing the sources of fleet demands.

Analysis of Fleet Demand

Analysis of the fleet demand on San Diego-based IMAs showed that 131 ships within 26 ship types were serviced in FY76, with 109 of them being homeported in San Diego; and 22, in other areas. Table 1 shows the number of ships in each type and the total number of IMA man-hours expended for each type.

As would be expected, the 109 ships homeported in San Diego dominated the work of the IMAs based there. Those ships made up 83 percent of all ships serviced in San Diego and accounted for 95 percent of the IMA ship workload. The remaining 22 ships made up 17 percent of all ships serviced and accounted for almost 5 percent of the workload, which was distributed among the homeports of Long Beach (2.0%), Concord (1.6%), and Port Hueneme, CA (0.1%); Portland, OR (0.2%); Seattle (0.1%) and Bremerton, WA (0.6%), and Yokosuka, Japan (0.2%).

Largest Customers

When the workload demand was aggregated by ship type and by homeport, it was found that, in both cases, the largest customers were frigates (FFs), destroyers (DDs), guided missile cruisers (nuclear) (CG(N)s), guided missile destroyers (DDGs), and amphibious transport docks (LPDs), in that order. These five ship types accounted for the following:

1. Almost 50 percent (N = 65) of the total number of ships serviced by the San Diego-based IMAs, and about 50 percent (N = 55) of the San Diego-homeported ships.
2. About 50 percent (1.469 million man-hours) of the total ship demand on the San Diego-based IMAs, 59 percent (.867 million man-hours) of the total ship demand on DATC/FMAG, San Diego, and 58 percent (.413 million man-hours) of the total ship demand of San Diego-homeported ships.

Table 1
Fleet Customers of San Diego-based IMAs, FY76

Symbol	Ship Type	Number Observed In Type	SD Homeported		Other Homeported		Total IMA Man-hours Expended
			No.	Man-hours Expended	No.	Man-hours Expended	
FF	Frigate	18	18	364,813	--	--	364,813
DD	Destroyer	18	8	291,138	10	57,040	348,178
CG(N)	Guided Missile Cruiser (Nuclear)	11 ^a	11	279,235	--	--	279,235
DDG	Guided Missile Destroyer	11	11	276,134	--	--	276,134
LPD	Amphibious Transport Dock	7	7	201,478	--	--	201,478
AD	Destroyer Tender	3	3	198,071	--	--	198,071
LSD	Dock Landing Ship	7	7	148,974	--	--	148,974
AR	Repair Ship	2	2	120,146	--	--	120,146
LST	Tank Landing Ship	10	10	118,680	--	--	118,680
LKA	Amphibious Cargo Ship	3	3	79,605	--	--	79,605
LPH	Amphibious Assault Ship	3	3	70,309	--	--	70,309
FFG	Guided Missile Frigate	3	3	69,063	--	--	69,063
ATF	Fleet Ocean Tug	7	7	63,711	--	--	63,711
CVA	Attack Aircraft Carrier	3	3	53,222	--	--	53,222
AE	Ammunition Ship	7	--	--	7	40,153	40,153
PG	Patrol Gunboat	2	2	27,209	--	--	27,209
LCC	Amphibious Command Ship	1	1	22,027	--	--	22,027
MSO	Nonmagnetic Minesweeper, Ocean	4	2	14,797	2	6,252	21,045
LPA	Amphibious Transport	1	1	15,829	--	--	15,829
AOE	Fast Combat Support Ship	2	--	--	2	14,396	14,396
ASR	Submarine Rescue Ship	2	2	9,411	--	--	9,411
AS	Submarine Tender	2	2	5,833	--	--	5,833
AVM	Guided Missile Ship	1	--	--	1	2,189	2,189
AGSS	Auxiliary Submarine	1	1	1,835	--	--	1,835
AGDS	Auxiliary Deep Submergence Support Ship	1	1	1,784	--	--	1,784
PGH	Patrol Gunboat, Hydrofoil	1	1	917	--	--	917
	Total	131	109	2,434,217	22	120,030	2,554,247

^aOne CG(N) was in port for only 5-1/2 months and required a total of 12,498 IMA man-hours. Since data were not available for this ship for the complete FY, it was included in computations to determine total IMA man-hours expended but not in those to determine average demand for ships within a ship type (see Table 3).

Average IMA Demand Rates

Blanco and Rowe hypothesized that aggregation may increase the accuracy of the forecasts of the various "final demand" specifications imposed on an input/output model.⁶ Thus, it seemed logical to test this hypothesis in determining final fleet demands on IMAs. Average demand rates for ships within a ship type were calculated for demand on DATC/FMAG, San Diego alone and for demand on the total San Diego-based IMAs (DATC plus three ADs and two ARs). Forecast accuracy was measured in terms of the relative variance of demands within a ship type, which was calculated by dividing the standard deviation of demands of ships within a type by the mean demand rate for ships within a type. The results of computations for the five largest customers are provided in Table 2 which shows that the reduction in relative variance due to aggregation ranged from 22 to 55 percent. Since these results clearly support the aggregation hypothesis, the analysis of fleet demand concentrated on total San Diego IMA demand, by ship type and homeport, to achieve more accurate forecasts.

Table 2

Comparison of Relative Variance (%) in Demands on
DATC/FMAG, San Diego Alone and on All San Diego-based IMAs, FY76

Ship Type	DATC/FMAG, San Diego Alone	All San Diego- based IMAs	Percent Improvement
FF	54	42	22
DD	62	48	23
CG(N)	69	44	36
DDG	55	29	47
LPD	42	19	55

Table 3 provides the average demand rates by ship type for San Diego-homeported ships during FY76. As shown, the ships were grouped into two categories, depending on whether or not they had undergone an overhaul (depot-level maintenance) during calendar year 1975 (6 months before and 6 months after the beginning of FY76). This was done to determine whether a recent overhaul would reduce the variance in IMA demand by ship type. A total of 30 ships in 13 ship types had undergone overhaul in FY75. As shown, for the 10 ship types that had ships in both categories, the average IMA demand rate (in man-hours) was significantly lower for ships that had undergone recent overhaul. For example, for the CVA, the average demand rate for ships with an overhaul was 6,254 man-hours, compared to 40,714 for those with no overhaul.

⁶Blanco, T., & Rowe, M. Problems and benefits of aggregation in a Navy workload forecasting input-output model. Paper presented at the joint national meeting of the Operations Research Society of America and the Institute of Management Sciences, May 1977, San Francisco, CA.

Table 3
Average Demand Rates for San Diego-homeported Ships

Symbol	Ship Type	Number Observed In Type	No Recent Overhaul			Recent Overhaul	
			No.	Avg. Demand (Man-Hours)	S.D.	No.	Avg. Demand (Man-Hours)
AD	Destroyer Tender	3	3	66,024	5,989	--	--
AR	Repair Ship	2	2	60,073	8,786	--	--
LPH	Amphibious Assault Ship	3	1	47,534	--	2	11,387
CVA	Attack Aircraft Carrier	3	1	40,714	--	2	6,254
LPD	Amphibious Transport Dock	7	5	37,809	7,203	2	6,217
DD	Destroyer	8	8	36,392	17,313	--	--
DDG	Guided Missile Destroyer	11	5	36,004	10,309	6	16,019
CG(N)	Guided Missile Cruiser (Nuclear)	10 ^a	7	32,048	13,604	3	14,133
LKA	Amphibious Cargo Ship	3	2	31,457	12,333	1	16,691
FFG	Guided Missile Frigate	3	3	23,021	13,603	--	--
LSD	Dock Landing Ship	7	5	22,853	9,694	2	17,354
FF	Frigate	18	15	22,685	9,604	3	8,177
LST	Tank Landing Ship	10	6	14,160	8,261	4	8,430
PG	Patrol Gunboat	2	2	13,604	2,823	--	--
ATF	Fleet Ocean Tug	7	7	9,102	5,312	--	--
ASR	Submarine Rescue	2	1	5,661	--	1	3,750
AS	Submarine Tender	2	2	2,916	941	--	--
AGSS	Auxiliary Submarine	1	1	1,835	--	--	--
AGDS	Auxiliary Deep Submergency Support Ship	1	1	1,784	--	--	--
PGH	Patrol Gunboat, Hydrofoil	1	1	917	--	--	--
LCC	Amphibious Command Ship	1	--	--	--	1	22,027
LPA	Amphibious Transport	1	--	--	--	1	15,829
MSO	Nonmagnetic Minesweeper, Ocean	2	--	--	--	2	7,396
Total		108	78			30	

^aAs indicated in Table 1, there were actually 11 CG(N)s serviced by San Diego-based IMA activities during FY76. However, since one was in port for only 5-1/2 months, data was not available for the complete fiscal year. Therefore, data for this ship was not included in computations to determine average demand rates for CG(N)s.

Although ships of the same type and category generally had similar workload demands, there were some exceptions. For some ship types, there were not enough ships in the data base to conclude that all ships of that type would have similar workload demands. Among San Diego-homeported ships with no overhaul, for example, 6 of the 20 types observed included data for only 1 ship. Further, since much intermediate ship maintenance is peculiar to an individual ship, it produces substantial variation in demand rates for ships grouped by type during a given year. To illustrate, again referring to San Diego-homeported ships with no overhaul, of the 13 types in which 2 or more ships were observed, 7 have a standard deviation that ranged from 40 to 60 percent of their mean average demand rate.

An attempt was made to reduce the variation in demand of ships within a ship type by considering ship age, displacement tonnage, and time since the last overhaul. As previously indicated, the average demand rates for ships having an overhaul within 6 months before and 6 months after the start of the fiscal year under study are significantly lower than those for ships with no overhaul (see Table 3). However, when average demand rates of ships not overhauled for periods of 1, 2, or 3 years were analyzed, it was found that time since the last overhaul had no effect on demand rates. Although variances in demand rates within a ship type did increase with time, the differences were not significant. Ship age and displacement tonnage had no effect on demand rates.

Table 4 provides the average IMA demand rates by ship type for ships homeported at other locations during FY76. Since the total demand from all "other" homeported ships was only 5 percent of the total ship demand (120,030 man-hours), this demand can be treated as a constant in I/O analysis.

DATC/FMAG, San Diego Proportion of Fleet Demand

As indicated earlier, to minimize forecast error, it is beneficial to forecast final demands on all San Diego-based IMA activities, rather than on DATC/FMAG, San Diego alone or on an individual tender. However, once the total demand forecast is made, workload must be allocated among DATC and the tenders and repair ships. Table 5 provides the proportion of total fleet demand that was placed on DATC in FY76 by ship type.

Analysis of Shore-based Activity Demand

Analysis of the shore-based activity demand on San Diego-based IMAs showed that 55 customers were serviced in FY76. The total man-hours required by these customers is provided in Table 6. As shown, the first two customers listed represented 55 percent of the shore-based demand; and the first nine, 83 percent.

Table 4

Average Demand Rates for Other Homeported Ships

Symbol	Ship Type	Number Observed In Type	Homeport	Number Observed	Average Demand (Man-Hours)	S.D.
DD	Destroyer	10	Long Beach Portland Seattle Yokosuka	4 1 1 4	10,953 5,263 1,904 1,516	3,506 -- -- 548
AOE	Fast Combat Support Ship	2	Bremerton	2	7,198	34
AE	Ammunition Ship	7	Concord	7	5,736	2,440
MSO	Nonmagnetic Minesweeper, Ocean	2	Long Beach	2	3,126	315
AVM	Guided Missile Ship	1	Port Hueneme	1	2,189	--
		<u>22</u>		<u>22</u>		

Table 5
Proportion of Fleet Demand Placed on
DATC/FMAG, San Diego Alone and on Other San Diego-based
IMA Activities, FY76

Ship Type	DATC/FMAG, San Diego Alone (%)	Other IMA Acts. (%)	Ship Type	DATC/FMAG, San Diego Alone (%)	Other IMA Acts. (%)
AD	9	91	DDG	53	47
AE ^a	90	10	FF	58	42
AGDS	100	--	PFG	65	35
AGSS	100	--	LCC	89	11
AOE ^a	99	1	LKA	72	28
AR	8	92	LPA	63	37
AS	89	11	LPD	72	28
ASR	100	--	LPH	77	23
ATF	67	33	LSD	74	26
AVM ^a	75	25	LST	70	30
CG(N)	61	39	MSO	31	69
CVA	93	7	MSO ^a	15	85
DD	61	39	PG	68	32
DD ^a	31	69	PGH	97	3

^aComputed for ships of this type not homeported in San Diego.

Table 6

Shore-based Customers of San Diego-based IMAs, FY76

Activity	Total IMA Man-Hours	% of Total Hours
Commander Naval Surface Force, Pacific	100,080	35.6
Development and Training Center, San Diego/Fleet Maintenance Assistance Group, Pacific	53,988	19.2
Commander Submarine Force, Group Five	18,319	6.5
Naval Station, San Diego	15,756	5.6
Seal Team One	15,429	5.5
Assault Craft Unit One	10,783	3.8
Service Group One	6,826	2.4
Coastal River Squadron One	5,733	2.0
Naval Sea Systems Command Support Center, San Diego	5,483	1.9
All Others (N = 46)	49,296	17.5
Total	281,693	100.0

CONCLUSIONS

The analysis of demands on the San Diego-based Intermediate Maintenance Activities (IMAs) permits some general conclusions regarding the feasibility of building an input-output (I/O) model of the fleet-support demand network.

1. Data are available to measure demands on IMAs in terms of total man-hours expended annually per ship. Although these data will fit into an I/O framework, analysis of the data is a laborious, time-consuming task. Close working relationships with members of the Development and Training Center's Management Division and the Supervisor of Shipbuilding Conversion, and Repair, San Diego were essential in interpreting the data.

2. Since ship type and the homeport of a ship affected the demands placed on the IMAs, the I/O model must stress the differences in workload attributable to the type of ship involved and the area where it is homeported.

3. The results of this study will be used, with results from analyses of demands on other major shore activities, to develop I/O coefficients for the IMA sector of the I/O model. For example, the I/O coefficient between the IMAs and the Naval Supply Center, San Diego might be measured in units of requisitions of supply per man-hour of intermediate maintenance.

4. Variance in IMA demand was affected not only by ship type and homeport, but also by the length of time since the last overhaul (if the overhaul was recent). Therefore, overhaul schedules must be considered when determining intermediate maintenance demands.

5. Since the San Diego-based IMAs service primarily San Diego-homeported ships, changing the homeport of ships is very likely to affect the workload of the IMAs.

RECOMMENDATIONS

1. Because of the large variance in IMA demand and/or few number of ships observed in some ship types, the demand rates should be updated each year for forecasting purposes.
2. This analysis should be extended to include other homeport-based IMAs to reflect total fleet IMA demand, and results should be incorporated into a Navy-wide I/O model.

PRECEDING PAGE BLANK-NOT FILMED

BIBLIOGRAPHY

- Blanco, T. A. Analysis of fleet and shore demands on the Naval Supply Center, San Diego (NPRDC Tech. Rep. 76TQ-39). San Diego: Navy Personnel Research and Development Center, June 1976. (AD-A035 589)
- Blanco, T. A., & Rowe, M. W. Analysis of demands on the Naval Air Rework Facility, North Island (NPRDC Tech. Rep. 77-21). San Diego: Navy Personnel Research and Development Center, March 1977. (AD-A037 799)
- Bokesch, W. M., & Wertz, D. A. Analysis of demands on the Naval Air Station, Miramar, CA (NPRDC Tech. Rep. 77-44). San Diego: Navy Personnel Research and Development Center, September 1977.
- Chipman, M. Analysis of demands on the Naval Regional Medical Center, San Diego (NPRDC Tech. Rep. 77-23). San Diego: Navy Personnel Research and Development Center, April 1977. (AD-A038 419)
- Rowe, M. W. Analysis of demands on the Long Beach Naval Shipyard (NPRDC Tech. Rep. 77-7). San Diego: Navy Personnel Research and Development Center, December 1976. (AD-A038 842)
- Whisman, A. W. Analysis of demands on the Navy Public Works Center, San Diego (NPRDC Tech. Rep. 78-2). San Diego: Navy Personnel Research and Development Center, November 1977.

PRECEDING PAGE BLANK-NOT FILMED

DISTRIBUTION LIST

Assistant Secretary of the Navy (Manpower, Reserve Affairs and Logistics)
Principal Deputy Assistant Secretary of the Navy (Manpower and Reserve Affairs)
Chief of Naval Operations (OP-987H), (OP-964D), (OP-121)
Chief of Naval Personnel (Pers-10c), (Pers-OR), (Pers-2B)
Chief of Naval Research (Code 450) (4)
Chief of Information (OI-2252)
Director of Navy Laboratories
Commandant of the Marine Corps (Code MPI-20)
Chief of Naval Education and Training (N-5)
Chief of Naval Technical Training (Code 016)
Chief of Naval Education and Training Support
Chief of Naval Education and Training Support (01A)
Commander Training Command, U. S. Atlantic Fleet (Code N3A)
Commanding Officer, Fleet Combat Training Center, Pacific (Code 00E)
Commander, Naval Data Automation Command
Commanding Officer, Naval Education and Training Program Development Center (2)
Commanding Officer, Naval Development and Training Center (Code 0120)
Commanding Officer, Naval Aerospace Medical Institute (Library Code 12) (2)
Director Training Analysis and Evaluation Group (TAEG)
Personnel Research Division, Air Force Human Resources Laboratory (AFSC),
Brooks Air Force Base
Occupational and Manpower Research Division, Air Force Human Resources
Laboratory (AFSC), Brooks Air Force Base
Technical Library, Air Force Human Resources Laboratory (AFSC),
Brooks Air Force Base
Flying Training Division, Air Force Human Resources Laboratory,
Williams Air Force Base
Technical Training Division, Air Force Human Resources Laboratory,
Lowry Air Force Base
Advanced Systems Division, Air Force Human Resources Laboratory,
Wright-Patterson Air Force Base
Program Manager, Life Sciences Directorate, Air Force Office of Scientific
Research (AFSC)
Army Research Institute for the Behavioral and Social Sciences
Military Assistant for Training and Personnel Technology ODDR&E, OAD(E&LS)
Director for Acquisition Planning, OASD(MRA&L)
Coast Guard Headquarters (C-P-1/62)
Defense Documentation Center (12)

PRECEDING PAGE BLANK-NOT FILMED